Oxygen transfer rates and requirements in oxidative biocatalysis

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Oxygen transfer rates and requirements in oxidative biocatalysis

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Biocatalytic oxidation reactions offer several important benefits such as regio- and stereoselectivity, avoiding the use of toxic metal based catalysts and replacing oxidizing reagents by allowing the use of oxygen. However, the development of biocatalytic oxidation processes is a complex task which requires simultaneous consideration of several issues regarding the process design and operation.

In this work, the oxygen requirements are analysed for different process scenarios, considering different biocatalyst formats and variation of the desired productivity. Also, the applicability of hollow fibre membrane contactors present an interesting alternative for reactor aeration, creating large specific areas (area/volume) of the gas/liquid interface. The modular design of membrane contactors, scaling-up is relatively straightforward (Gabelman and Hwang, 1999), and membrane contactors are implemented for various industrial applications (Klaassen et al., 2005).

![Figure 1: Illustration of a cell that catalyzes a specific hydroxylisation reaction (A), generates energy via the citric acid cycle (B) and the electron transport chain (C). The energy enables maintenance of cellular function (mATP) and growth (μ).](image)

**Conclusions**

- The maximum achievable productivity is greatly influenced by the oxygen requirement set by the biocatalyst.
- Maximum productivities of 3.5 and 5 g/L·h were estimated for growing and resting cells respectively, using conventional bubble aeration.
- Membrane aeration is limited in terms of maximum oxygen flux. Thus, the use of pure oxygen may be necessary in order to support the desired productivity.
- Bubble-less aeration would be particularly relevant to systems using sensitive enzymes. It may also be beneficial in order to minimize the evaporation of volatile components.

**References**


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